

FABRICATION OF HYBRID AIR ATV REAR SUSPENSION SYSTEM

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ABSTRACT

This thesis deals with the fabrication of Hybrid Air ATV rear suspension. The objectives are to reverse engineering of independent rear suspension unit for ATV motorcycle and to fabricate the working prototype of rear suspension unit for ATV motorcycle. The scope identified are design a suitable suspension for ATV motorcycle and fabricate the rear suspension using a provide materials and machine. There are many steps taken to fabricate this ATV motorcycle. The first stage of these steps is do some Literature review about suspension unit. The second steps is planning the suspension unit to combine the chassis body . The design of suspension unit are provided by senior of project .Next stage is do some work like welding ,cutting , drilling, and marking. Thus ,finishing this project ,the objectives of the project is achieved. Finally ,the conclusion about this project and the recommendation for the future plan also attached together with this thesis.

ABSTRAK

Tesis ini membicarakan pembuatan suspensi belakang udara hybrid untuk ATV . Objektif projek ini adalah untuk menterbalikkan kejuruteraan unit bebas suspensi belakang untuk motosikal ATV dan untuk mereka prototaip unit suspensi belakang untuk motosikal ATV. Skop yang dikenalpasti adalah reka bentuk suspensi yang sesuai untuk motosikal ATV. Terdapat banyak langkah-langkah yang diambil untuk mereka motosikal ATV. Peringkat pertama adalah melakukan beberapa kajian Kesusasteraan tentang unit penggantungan. Langkah yang kedua adalah perancangan unit penggantungan untuk menggabungkan badan casis. Reka bentuk unit penggantungan disediakan oleh kanan projek. Peringkat Seterusnya membuat kerja-kerja seperti kimpalan, memotong, penggerudian, dan penandaan. Oleh itu, menyelesaikan projek ini, objektif projek tercapai. Akhir sekali, kesimpulan mengenai projek ini dan cadangan untuk rancangan masa depan juga dilampirkan bersama-sama dengan tesis ini.

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LIST OF ABBREVIATIONS

ATV	All Terrain Vehicle
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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter is written to explain about the project background ,project objective, project scope and the project flow that been conducted. Besides that, it also consists of flow chart and Gantt chart of the project which explain the overall procedure and how time is being distributed for this project.

1.2 PROJECT BACKGROUND

Suspension is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems serve a dual purpose, contributing to the vehicle's road holding/handling and braking for good active safety and driving pleasure, and keeping vehicle occupants comfortable and reasonably well isolated from road noise, bumps, and vibrations, etc. (Reza N. Jazar (2008).Vehicle Dynamics: Theory and Applications. Spring. p.455. Retrieved 2012-06-24.)

These goals are generally at odds, so the tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the road or ground forces acting on the vehicle do so through the contact patches of the tires. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The design of front and rear suspension of a car may be different.

For the history based on the suspension system, Leaf springs have been around since the early Egyptians. Ancient military engineers used leaf springs in the form of bows to power their siege engines, with little success at first. The use of leaf springs in catapults was later refined and made to work years later. Springs were not only made of metal, a sturdy tree branch could be used as a spring, such as with a bow.

In a Horse drawn vehicle, By the early 19th century, most British horse carriages were equipped with springs; wooden springs in the case of light one-horse vehicles to avoid taxation, and steel springs in larger vehicles. These were made of low-carbon steel and usually took the form of multiple layer leaf springs. (Peter Chamberlain and Hilary Doyle, Encyclopedia of German Tanks of World War Two, 1978, 1999)

The British steel springs were not well suited for use on America's rough roads of the time, and could even cause coaches to collapse if cornered too fast. In the 1820s, the Abbot Downing Company of Concord, New Hampshire re-discovered the antique system whereby the bodies of stage coaches were supported on leather straps called "thorough braces", which gave a swinging motion instead of the jolting up and down of a spring suspension. ([http://en.wikipedia.org/wiki/Suspension_\(vehicle\)](http://en.wikipedia.org/wiki/Suspension_(vehicle)))

Automobiles were initially developed as self-propelled versions of horse drawn vehicles. However, horse drawn vehicles had been designed for relatively slow speeds and their suspension was not well suited to the higher speeds permitted by the internal combustion engine.

In 1901 Mors of Paris first fitted an automobile with shock absorbers. With the advantage of a dampened suspension system on his 'Mors Machine', Henri Fournier won the prestigious Paris-to-Berlin race on the 20th of June 1901. Fournier's superior time was 11 hrs 46 min 10 sec, while the best competitor was Léonce Girardot in a Panhard with a time of 12 hrs 15 min 40 sec.

In 1920, Leyland Motors used torsion bars in a suspension system. In 1922, independent front suspension was pioneered on the Lancia Lambda and became more common in mass market cars from 1932. (Jain, K.K.; R.B. Asthana. Automobile Engineering. London: Tata McGraw-Hill. pp. 293–294)

1.3 PROBLEM STATEMENT

Fabrication can be done on a normal swing arm to support absorber and the chassis of the ATV. But, it is exactly difficult to fabricate the prototype as same as the design.

Therefore it is necessary to solve the problems of fabrication to ensure the fabricated prototype is as close as possible to the design and that a high quality rear suspension is fabricated so that it can give high comfort to the rider.

1.4 PROJECT OBJECTIVES

There are two main objectives to achieve in this project which is to reverse engineering of independent rear suspension unit for ATV motorcycle and to fabricate the working prototype of rear suspension unit for ATV motorcycle.

1.5 PROJECT SCOPE

In order to achieve the objective ,there are scopes of project which is to design the suitable suspension for ATV motorcycle. Otherwise, to fabricate the rear suspension using provide materials and machine and do some literature review.

1.6 FLOW CHART

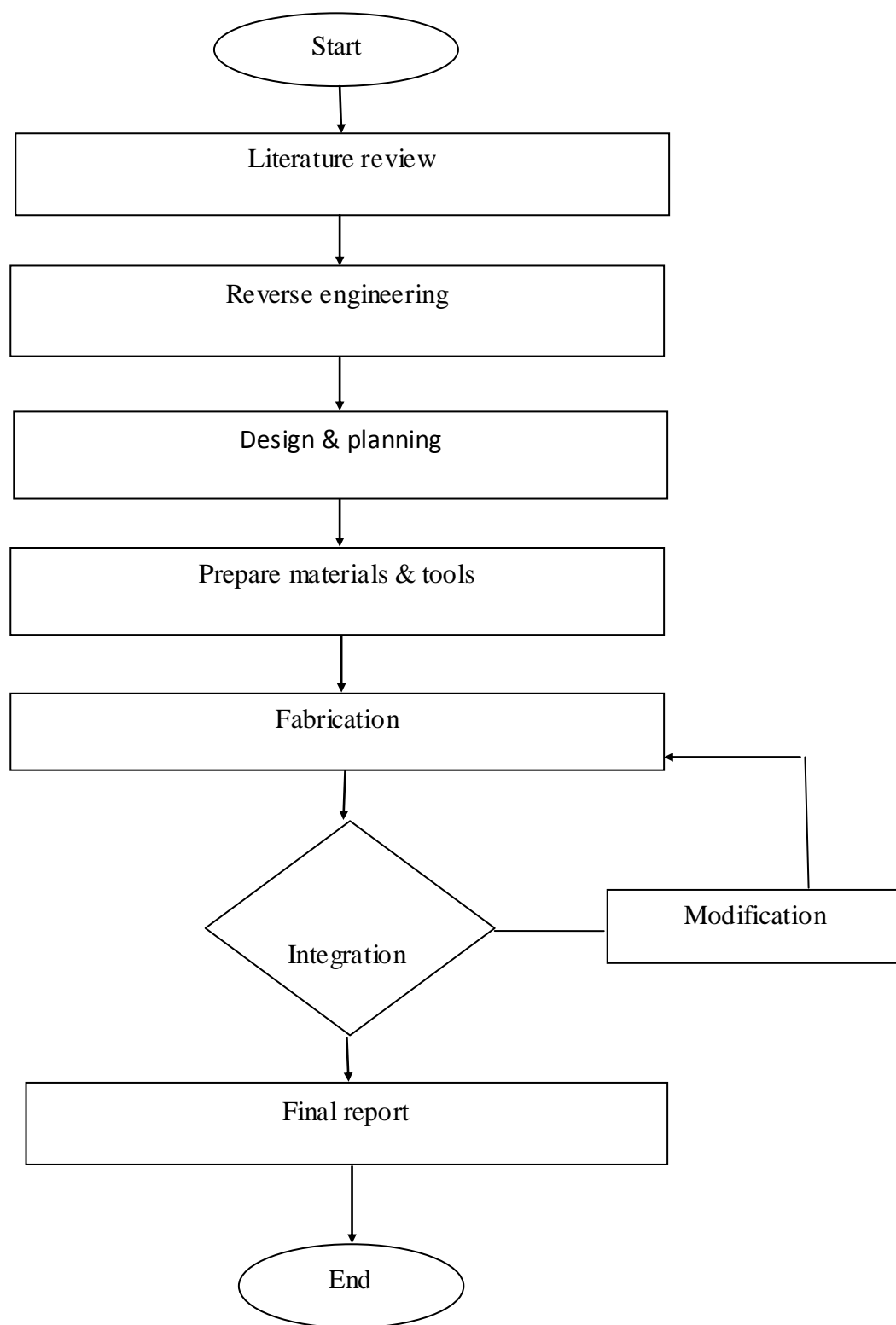


Figure 1.1 : Flow chart

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter explains about literature review would be done, which include the theory about rear suspension system. Usually the rear suspension system is build because of customer need towards the comfortable when drive or cycling. The manufacturer always do some research to make a suspension like rear or front more improve or better than before. They use many technologies to create a modern suspension. The first stage in achieving a good rear suspension that will provide the greatest percentage of power efficiency is to go right back to basics of the rear suspension system. (www.monroe.com/en-US/support/.../Suspension-System-Fundamentals/)

The rear suspension system is back part of the vehicle especially ATV that including the springs, shock absorber, struts, control arms and spindle. The primary function of the suspension is to provide vertical compliance so the wheels can follow the uneven road, isolating the chassis from roughness in the road. Otherwise, it also maintain the wheels in the proper steer and camber attitudes to the road surface and also

react to control forces produces by the tires. Furthermore ,it also resist roll of the chassis and keep the tires in contact with the road with minimal load variations.

There are main categories of rear suspension system like independent and non-independent.

2.2 TYPES OF THE SUSPENSION SYTEM.

There are two types of the suspension system on the vehicle like car ,ATV and etc. the first types is independent suspension system and the second types is non-independent suspension system. This two types of rear suspension will be discuss on the next chapter .

2.2.1 Independent suspension system

Independent suspension is a broad term for any automobile suspension system that allows each wheel on the same axle to move vertically independently of each other. This is contrasted with a beam axle, live axle or de Dion axle system in which the wheels are linked – movement on one side affects the wheel on the other side. Note that “independent” refers to the motion or path of movement of the wheels/suspension. It is common for the left and right sides of the suspension to be connected with anti-roll bars or other such mechanisms. The anti-roll bar ties the left and right suspension spring rates together but does not tie their motion together.(https://en.wikipedia.org/wiki/Independent_suspension).

Most modern vehicles have independent front suspension . Many vehicles also have an independent rear suspension . Independent rear suspension , has the rear wheels independently sprung. A fully independent suspension has

an independent suspension on all wheels. Some early independent systems used swing axles, but modern systems use Chapman or Mac Pherson struts, trailing arms, multilink, or wishbones.

Independent suspension typically offers better ride quality and handling characteristics, due to lower unsprung weight and the ability of each wheel to address the road undisturbed by activities of the other wheel on the vehicle. Independent suspension requires additional engineering effort and expense in development versus a beam or live axle arrangement. A very complex independent rear suspension solution can also result in higher manufacturing costs.

The key reason for lower unsprung weight relative to a live axle design is that, for driven wheels, the differential unit does not form part of the unsprung elements of the suspension system. Instead it is either bolted directly to the vehicle's chassis or more commonly to a sub frame. The figure above shows the independent suspension system works.
([http://en.wikipedia.org/wiki/Suspension_\(vehicle\)](http://en.wikipedia.org/wiki/Suspension_(vehicle)))



Figure 2.1: Independent suspension

Source : H & H trikes inc. (1999)

2.2.2 Advantage of the independent suspension system

This system provides many advantages over other suspension systems. For example, in solid axle suspension systems, when one wheel hits a bump, the wheel across from it is affected as well as the one that hit the bump. This will compromise traction, smoothness of the ride, and could also cause a dangerous wheel shimmy when moving at high speeds. According to “Car Suspension Bible” with independent suspension systems, only the wheel that hits the bump would be affected. This offers many advantages such as greater ride comfort, better traction, and safer, more stable vehicles on and off the road .

2.2.3 Disadvantage of the independent suspension system.

The disadvantage of the independent suspension system, weight is take place on the vehicle. Otherwise, the independent suspension system also have complicated pieces of equipment .Furthermore, it also quite expensive that another types of suspension system.



Figure 2.2: the independent suspension system

Source : H & H trikes inc.(1999)

2.2.4 Non independent suspension system

The suspension arms or axles connect the wheels and tires to the frame and allow the tires and wheels to move up and down depends on surface. Otherwise , Solid axles are strong and, relatively inexpensive and A car with solid axles will usually have a harsher ride than a car with an independent suspension.

Overall, non-independent suspensions are less adept than independent varieties at isolating vehicle occupants from bumps and dips in the road. This is because a jolt on one side travels through the shared axle and affects the opposite wheel and, often, the chassis as well.

Non-independent suspensions should not be considered substandard in all cases, however. For example, Jeep uses non-independent axles in both the rear and front of its Wrangler because it affords an advantage in some off road situations. Most sport utility vehicles designed for true off road use employ a non-independent rear suspension.

Reference :([http://en.wikipedia.org/wiki/Suspension_\(vehicle\)](http://en.wikipedia.org/wiki/Suspension_(vehicle)))

2.2.5 Advantage of non independent suspension system

For the non independent suspension system , there is a advantages like the left and right wheels bounce mutually implicated ,the tire angle changes in the amount of small tire wear. Otherwise ,the decrease of the body height is not easy to change the angle of the wheel ,so that steering feeling is consistent and in non independent suspension system also have a simple structure ,low manufacturing cost ,and easy maintenance. Furthermore ,it also take up less

space ,can reduce the height of the car floor. In addition ,left and right wheels bounce mutually implicated, and reduce ride comfort and control stability. Simple structure design freedom ,manipulation of the stability is poor and suspension system is shortcomings.

2.2.6 Disadvantage of non independent suspension system

In non independent suspension system ,there is disadvantage of this system that independent didn't have like less adept than independent suspension system. Otherwise, this type of suspension system is not suitable for ATV because of harsher ride when drive at rough surface.

2.3 SPRINGS

ATV use metal coil springs usually made of steel attached to the outside of the damper. They have specific performance characteristics that determine by the spring wire diameter, coil diameter, pitch, and material quality. Springs are designed to absorb the impacts and bumps as the ATV is ridden. There are three different types of coil springs used on ATV suspension systems: single, dual, and progressive rate.

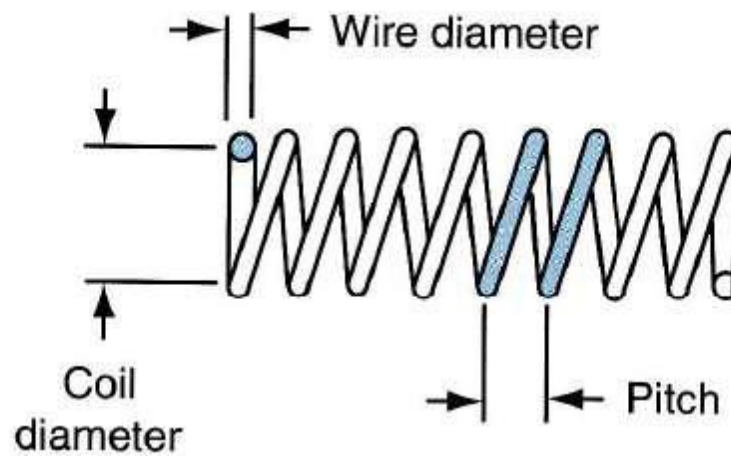


Figure 2.3 : specific performance characteristics of springs

Source : Ed Abdo ,modern motorcycle & ATV technology(1985)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The methodology had been done right after the motivation and objectives of the project were identified. This methodology functioned as guidance in order to complete the project given. The completed structure of methodology had been illustrated and planned as guideline to achieve the objectives of the project.

3.2 SKETCHING

There were 3 sketches including a reference. The entire concepts are screened and after the screening process, the best sketching is converted or apply into the solid work drawings. This sketches were made based on the ideal concept and as followed:

3.2.1 Concept 1

This is the basic design of the rear suspension system unit for ATV. This design is need about one materials and three part to combined to make a rear suspension system.

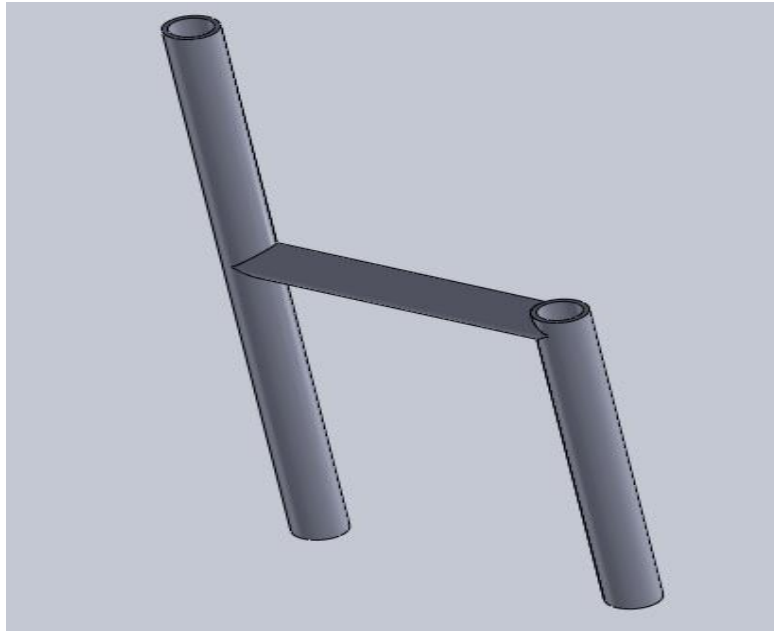


Figure 3.1: Concept 1

Table 3.1: Advantages and disadvantages of concept 1

Advantages	Disadvantages
Simple design	This concept is not strong enough to be placed into the chassis of the ATV
Didn't use many materials	Easy to fracture
Not complicated to make it	

Table 3.1 shows the advantages and disadvantages of the design concept 1 .This design is the simplest design than another two . It also easy to construct and didn't use many materials so that the cost can be reduce. But , this concept design have more problem because it is not strong enough to be placed into the chassis of the ATV as the force that imposed at the ATV is huge. Otherwise, the design also easy to fracture due to the large force that imposed on the suspension.

3.2.2 Concept 2

This design is improved to make more stable and strong . This design also more wider that design 1 that suitable to place the tire and the absorber . This design is used one materials and 4 junction as can see below:

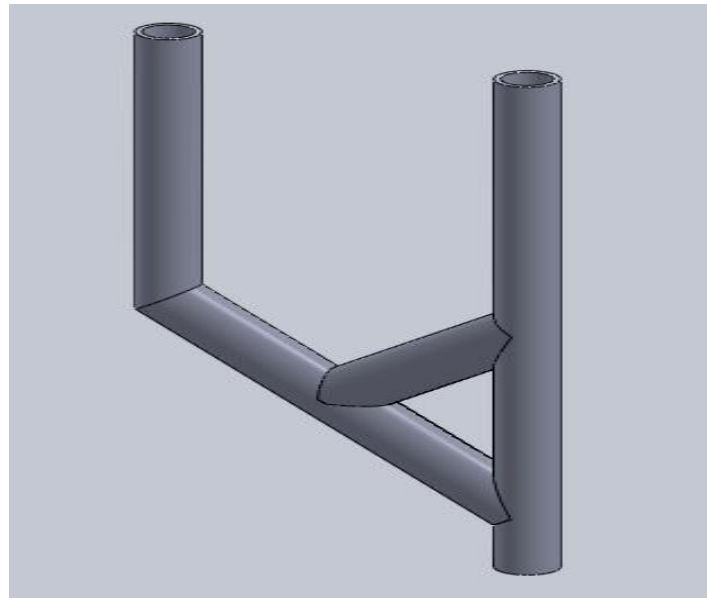


Figure 3.2: Concept 2